

## Production of Mesons by X-Rays

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AT THE 1949 SPRING MEETING of the National Academy of Sciences (2) a preliminary account was given of some observations of mesons produced by the 335-Mev x-ray beam from the Berkeley synchrotron. The present paper is a progress report of this work; no claim is made for completeness, but sufficient new data are available to make publication at this time worth while, especially since some of the numerical results given in the earlier report require revision.

The x-ray beam, produced by the impact of 335-Mev electrons on a 20-mil-thick platinum target, has a width at half-maximum of 0.0135 radian (about 1 inch at 6 feet from the target). In all but the earliest experiments the beam was further defined by a 1-inch hole in a lead block, then passed through a piece of carbon, which served as the meson source. The x-ray intensity at one meter from the target was about 3500 roentgens (r) per hour, measured behind  $\frac{1}{4}$ th inch of lead under the best running conditions; the average was about half this. The actual exposures at the carbon meson source (6 feet from the target) ranged from 500 to 2000 r in the later runs. Mesons were recorded on Ilford nuclear plates; the highest density of meson endings observed was about 100 per square centimeter in a 100-micron emulsion. In the following sections the experimental conditions and some of the results are described in more detail.

**Plate Exposure.** Plates have been exposed in the following ways:

**Geometry 1:** A stack of plates is traversed directly by the x-ray beam. Mesons are produced chiefly in the glass plates, and exposures are limited by the general blackening due to the beam. Meson tracks are counted in the part of the plates not overexposed by the central core of the beam. There is an appreciable background of photonuclear stars and proton tracks. Only Ilford F-3 plates were used in these exposures.

**Geometry 2:** The x-ray beam passes through a carbon slab, and the stacks of plates are placed alongside, out of the core of the beam. The intent was to deter-

mine the element in which the mesons are produced, but it was found that the wings of the beam had sufficient intensity at the location of the plates to make this somewhat doubtful, considering the fact that there was much more matter in the plates than in the carbon slab used. The background was considerably less than in Geometry 1, and longer exposures could be made; only F-3 plates were used.

**Geometry 3:** Same as Geometry 2, except that a lead collimator 6 in. thick with a 1-in. hole cuts off the wings of the beam. The x-ray intensity at the plates is now small, and they show little general blackening except along their leading edges; the heavy-particle background is very small. Both F-3 and C-2 plates were used.

**Geometry 4:** A modification of Geometry 3, with the following changes: A secondary collimator protects the plates from electrons scattered off the edge of the main collimator; the carbon slab is replaced by a cylinder of 1-in. diameter; stacks of plates are arranged radially around this cylinder, with different thicknesses of lead absorbers between the carbon and the plates, as shown in Figs. 1 and 2. Data reported for this geometry were all recorded on C-2 plates.

**Types of Meson Tracks.** The following types of features are seen at the ends of meson tracks in nuclear emulsions:

- (a) Stars of two or more prongs;
- (b) Stars of one prong;
- (c)  $\mu$ -meson tracks;
- (d) Small "blobs" of a few grains;
- (e) Nothing.

Events of type (a) and (e) are obviously recognizable, and require no further discussion. Events of type (d) are not always clearly enough defined to distinguish from (e), and therefore counts of these events cannot be used for statistical purposes, even though they probably represent vestigial stars, being due to the recoils following neutron ejection. In practice, (d) and (e) are lumped together as  $\rho$ -mesons.

Particular care is needed in distinguishing events of types (b) and (c) from one another. If the secondary track is heavy, it is clearly a star; if it is light, and of sufficient length to show the characteristic scattering and change in grain density, it is clearly a  $\mu$ -track. If it is light but leaves the emulsion too

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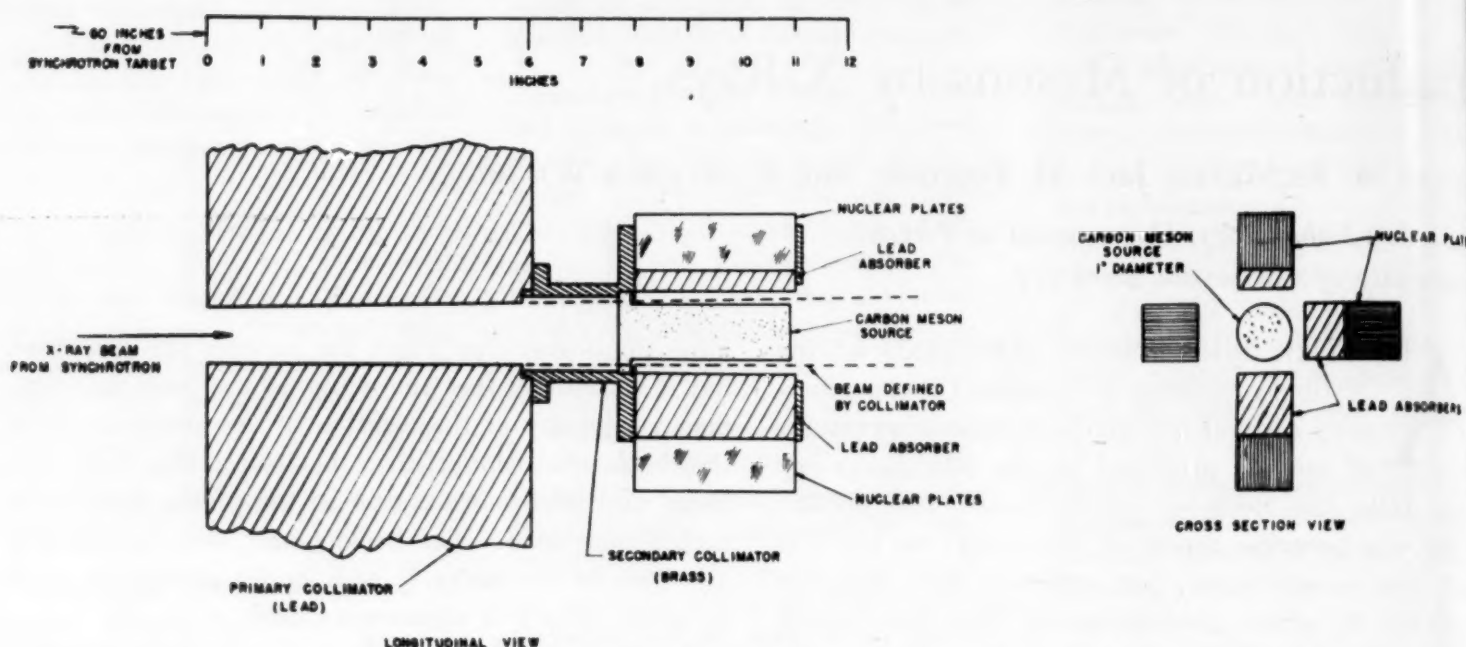


FIG. 1. Drawing of experimental arrangement (Geometry 4).

soon, there is a possibility of confusion. However, examination of magnetically sorted negative mesons produced in the cyclotron and recorded on Ilford C-2 plates shows that light single-pronged star tracks are almost invariably accompanied by blobs resulting from the recoil consequent on the emission of a very fast proton. Therefore, single light secondary tracks

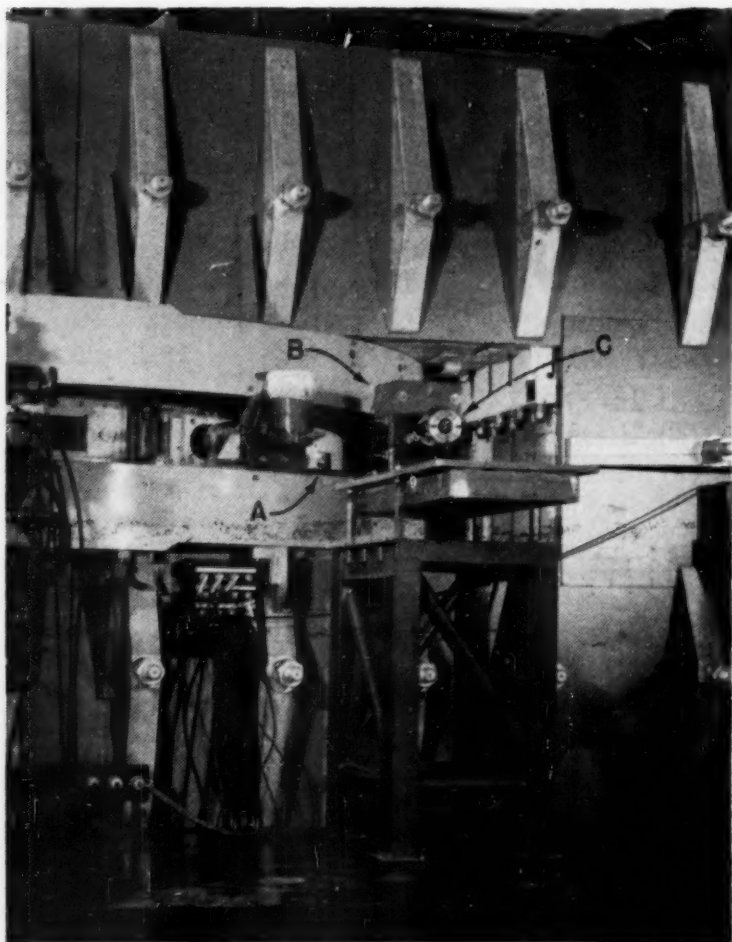


FIG. 2. Photograph of experimental arrangement (Geometry 4). The x-ray beam emerges from the synchrotron through the rectangular hole (A). The 6-inch-thick lead collimator is at B. C is the plate holder.

with no blobs are recorded as  $\mu$ -tracks, even though the observed range may not be long enough for positive identification.

We finally arrive at three classifications of meson track endings:

- (a) + (b), denoted by  $\sigma$
- (c), denoted by  $\pi\mu$
- (d) + (e), denoted by  $\rho$ .

It is desired to compute from these the numbers of negative and positive  $\pi$ -mesons ( $\pi^-$  and  $\pi^+$ ) stopping in the emulsion.

**Methods of Computation.** (a) Computation of  $\pi^-$ . Negative  $\pi$ -mesons are assumed to be captured in the emulsion, and may or may not make recognizable stars. Therefore, it is important to know the fraction of cases in which stars are produced. Data on this are available from counts of tracks in Ilford C-2 plates due to magnetically sorted negative mesons (1). In these plates, it was found that the ratio  $\rho/(\sigma + \rho) = 0.27$ ; we deduce that, in Ilford C-2 plates,  $\pi^- = 1.37 \sigma$ . (b) Computation of  $\pi^+$ . **Method A.** If the plates are sufficiently sensitive to show the early parts of  $\mu$ -tracks with certainty, then the number  $\pi\mu$  is essentially equal to  $\pi^+$ . Experiments with magnetically sorted positive mesons (3) show that in C-2 plates at least 95 percent give recognizable  $\pi$ - $\mu$  decay. Therefore, when using these plates, it is assumed that  $\pi^+ = \pi\mu$ . The number  $\rho$  does not enter into this computation. **Method B.** If, on the other hand, less sensitive plates are used, as for example Ilford F-3, it is harder to recognize the  $\mu$ -tracks and a considerable fraction of them may be missed. Then a different method must be used, which is based on the assumption that all tracks not associated with negative  $\pi$  mesons, i.e., a number equal to  $\sigma + \pi\mu + \rho = 1.37 \sigma$ ,



consist of  $\pi^+$  tracks plus an equal number of  $\mu$  tracks. The distinction between  $\pi\mu$  and  $\rho$  does not enter into this calculation. This method may underestimate the true number, since the  $\mu$ -particles are emitted in random directions in the emulsion and glass of the plates, and therefore a certain fraction of these will end while crossing the emulsion at unfavorable angles for identification, while the  $\pi$ -particles are traveling approximately parallel to the emulsion. Without attempting to correct for this, the Method B calculation assumes that:

$$\pi^+ = (\frac{1}{2}) (\sigma + \pi\mu + \rho - 1.37 \sigma).$$

**Results.  $\pi^-/\pi^+$  ratio.** At the time of writing the abstract for the National Academy meeting (2) 145 tracks were available, of which 51 were from Geometry 1 and 94 from Geometry 2. All of these were on F-3 plates, and therefore only Method B could be used for the computation, giving the published ratio  $\pi^-/\pi^+ = 10$ . By the time of the meeting, more tracks were available, including some on Geometry 3. The Geometry 1 tracks were then discarded, since they represent mesons starting in glass rather than carbon. The new total of 198 tracks (103 on Geometry 2 and 95 on Geometry 3), mostly on F-3 plates and analyzed by Method B, gave  $\pi^-/\pi^+ = 7.5$ , which was the value reported verbally at the meeting.

Since then, more tracks have become available, and it is now possible to give data obtained entirely with Geometry 4, using C-2 plates, and analyzed by Method A. Blank runs, with no carbon target in place, prove that virtually all the mesons seen actually originate in the carbon. In this setup there are plates behind lead absorbers, on which mesons of higher energy are recorded. The energy ranges are assumed to be defined by the stopping power of the absorber (including the radius of the carbon cylinder) for one limit, and that of the absorber plus the plate width for the other. No obliquity correction was applied. The values found for the ratio  $\pi^-/\pi^+$  in the various energy bands, covering a range from about 30 to 150 Mev, agree within the statistical errors, which are about  $\pm 25$  percent for bands about 10 Mev wide below 100 Mev, and  $\pm 50$  percent for a band between 100 and 150 Mev. Since there is no statistically significant evidence for a variation with meson energy, the data are lumped together, including only track counts made or checked by experienced observers. These counts are:  $\sigma = 403$ ,  $\pi\mu = 327$ ,  $\rho = 323$ . Using Method A, the ratio  $\pi^-/\pi^+ = 1.7$ , with a statistical standard error of 8 percent. Method B applied to the same data gives  $\pi^-/\pi^+ = 2.2$ , indicating the sort of error to be expected when the latter is used with C-2 plates; it may be still greater with F-3 plates, on which the tracks are harder to find. It will be noted that this ratio is less than the previously given values. The

difference from the earlier values may be partly real, that is, the Coulomb effect for very low energy mesons made in glass may distort the ratio somewhat; a considerable part of the difference certainly comes from the errors inherent in the use of Method B with

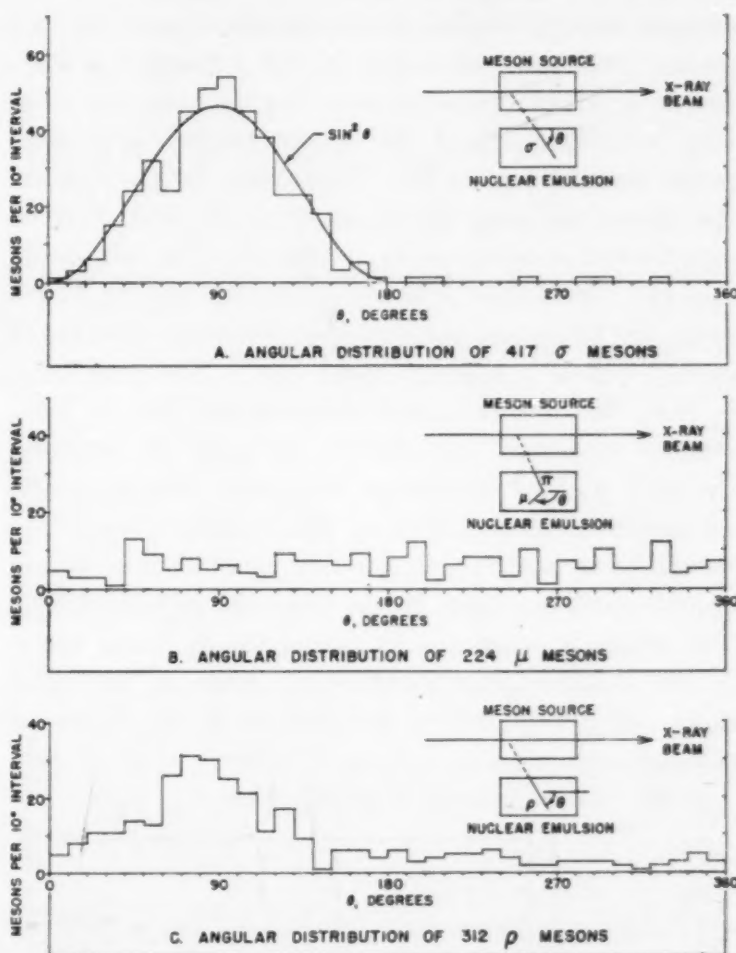


FIG. 3. Angular distributions of meson tracks in the energy range 43 to 59 Mev. (A)  $\sigma$ -Mesons. The curve  $\sin^2 \theta$  represents approximately the distribution to be expected in case of spherically symmetrical emission from all parts of the carbon target. The few tracks in the range  $180^\circ$  to  $360^\circ$  were probably scattered.  $\pi$ -Mesons associated with  $\pi\mu$ -decay give a similar distribution. (B)  $\mu$ -Mesons associated with  $\pi\mu$ -decay. There is no evidence here of departure from spherical symmetry. (C)  $\rho$ -Mesons. This distribution is clearly composite, the peak at  $90^\circ$  being due to  $\pi^-$  mesons that fail to make visible stars, while the uniform background is due to  $\mu$ -mesons.

F-3 plates, and some may be attributed to inexperience of the observers in the beginning.

The ratio of 1.7 does not pose the formidable theoretical problem offered by the earlier value; in fact a ratio of this order can be explained on rather elementary grounds. Consider the products of the reactions, which are  $\pi^-$  and  $\pi^+$  in one case, and  $\pi^+$  and  $n^0$  in the other. The current accompanying the process is greater in the former because of the contribution of the recoil proton, and therefore the coupling to the photon field is larger. This effect, which increases with meson energy, plus the Coulomb effect on the meson wave function, which decreases with energy, together can account for the observed ratio. A de-

tailed discussion of this will be given in a later publication by K. A. Brueckner.

**Yield of Mesons. Energy and Angle Distributions.** From the data obtained with Geometry 4, some information can be gained on the distribution of mesons in angle and energy, as well as the total yield. The distribution of angles of the straight parts of the tracks (excluding of course  $\mu$  and  $\rho$  tracks) is consistent with that to be expected for an isotropic emission from all parts of the carbon target. The computed distribution on this assumption, in the case of the plates covering the band 43 to 59 Mev, can be represented approximately by  $\sin^2 \theta$ . Fig. 3A shows that the data agree with this. Higher energy plates show the expected narrower distribution, and lower energy plates a slightly wider one. The conclusion is that the initial meson distribution has at least roughly spherical symmetry. In order to compute the total number of mesons in a given energy range, we then use the fact that an ideal infinite line source would give a uniform angular distribution, whose height would be equal to the observed height at  $90^\circ$ . The height is computed by fitting the expected shape to the observed distribution—or, what is the same thing, the total number is taken to be the observed number multiplied by a "shape factor," which is just 2 in the case of the  $\sin^2 \theta$  distribution.

The differential yield  $\frac{dN}{dE}$  can now be computed from the following formula:

$$\frac{dN}{dE} = 4r \frac{dR}{dE} \frac{1.37 \sigma + \pi\mu}{At} \times \text{shape factor},$$

where  $N$  = No. of mesons produced per cm length of target

$E$  = energy of mesons

$r$  = radius to center of area scanned

$R$  = range of mesons in glass or emulsion (these are nearly equal)

$\sigma, \pi\mu$  are track counts in area  $A$  of emulsion

$t$  = thickness of emulsion during exposure (a shrinkage factor of 2.4 was used).

The shape factor varies from 1.8 to 4.3.

The results, normalized to an exposure of 1 r, are given in Fig. 4, with standard errors from the track counting statistics alone. The most likely other errors are losses at the low energy end from self-absorption in the carbon, and at the high energy end from scattering in the lead absorbers.

The absolute value of the cross section can be obtained from the integral of Fig. 4, if the number of quanta corresponding to the rather arbitrary unit "r behind  $\frac{1}{8}$ th inch of Pb" is known. This has been measured, using a thin air chamber intercepting the whole beam as defined by the collimator, with thin layers of

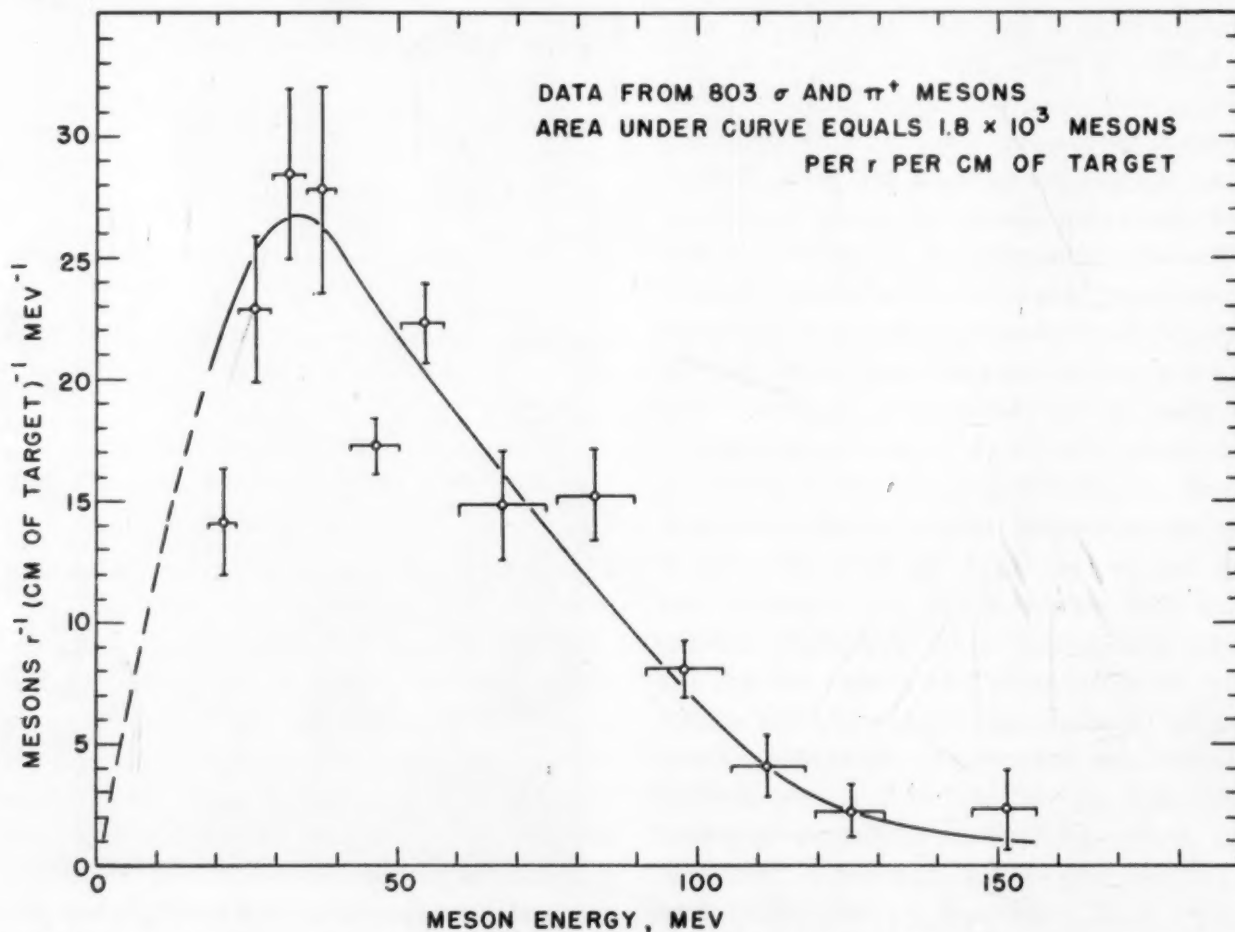


FIG. 4. Distribution of meson energies from x-ray energy of 335 Mev. The apparent lower limit on the energy is caused by the fact that the energies are computed as if the mesons originated in the center of the carbon block. The dotted line is simply a guess as to the trend of the distribution at low energies, which was used in the integration leading to the total cross section.



lead and other substances in front in order to be able to estimate the amount of the ionization due to pair production alone. This will be described in detail in a later publication; the result was that 1 r on the carbon corresponds to  $4.9 \times 10^7$  quanta traversing it, where the number of quanta is defined as the total x-ray energy divided by the upper limit energy. (The actual number of quanta in a range between  $E_1$  and  $E_2$  is approximately  $\ln (E_2/E_1)$  times the above number.) The total cross section per quantum per carbon nucleus is then found to be  $5 \times 10^{-28}$  cm<sup>2</sup>. It is hard to make an estimate of the over-all accuracy of this figure, but it is probably not wrong by more than a factor of 2. The difference between this value and that given in reference 2 is easy to under-

stand, since the latter, made from Geometry 1 plates, included only very low energy mesons. One run was made at an x-ray energy of 200 Mev; here the meson energy distribution extends only to about 35 Mev, and the yield is considerably less than at 335 Mev. Because of the large self-absorption of the mesons at this energy, no attempt was made to calculate a cross section.

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## Experimental Control in Hypnotic Age Regression States

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THE RECOVERY OF EARLY CHILDHOOD MEMORIES, lost through the ordinary processes of forgetting or because of subconscious repression, has a definite place in modern psychotherapy. The importance of catharsis has long been recognized, but too little work has been carried out to determine whether hypnotic age regression is a fact, or, as Young (4) believes, an artifact. Too few adequately controlled experiments have been carried out which separate and distinguish between half-conscious dramatization of current memories of a previous time and actual revivification of behavior patterns of a suggested earlier period of life in terms of what actually belongs there. Since both conditions may exist during a sitting, the importance of constant control cannot be overemphasized. Erickson and Kubie (1) recognized the existence of these two states and yet utilized hypnotic age regression with a great deal of success in the treatment of hysteria without determining which state was involved. The fact that psychotherapy based upon a supposed memory is of value to a patient is hardly satisfactory evidence of a true regression, since it is always possible that a pseudomemory may be effective in such a case (3). This has been shown quite con-

clusively in the use of play or dramatic therapy, both in the waking state and during hypnosis.

Information from relatives, verbal material memorized at an early age, and diaries are unsatisfactory controls, since the normal processes of forgetting must be considered in the first case, the possibility of review in the second, and the recognized inaccuracy of diaries written at an early age in the last case. The factor of the recall of very recently learned material may be of value from an academic viewpoint but is obviously unsatisfactory for hypnoanalytical purposes, where remote memories are of primary importance.

For the most part, the use of hypnosis in age regression has been interpreted in terms of a hypothetical state called *dissociation*. Psychoanalysis and hypnoanalysis are actually doctor-patient battles, with the patient trying to retain his compulsions and the operator equally determined to eliminate them. The evidence points at the fact that the recall of actual traumatic experience is more efficacious in bringing about beneficial results in the treatment of a neurosis than the reliving of an imagined experience (2), although it must be recognized that neither one invariably brings about the desired therapeutic change.

It is easy to see the importance of certain controls in determining whether or not actual age regression has occurred. The writer has devised a method of control which has proved effective in 82.3 percent of a mixed group, as shown in Table 1. Before induc-

TABLE 1  
HYPNOTIC AGE REGRESSION STATES OF 50 SUBJECTS  
(40 MALES, 10 FEMALES; AGES 20-24)

	No. of subjects	Per- centages	Male	Female
<b>Age 10</b>				
Birthday :				
Correct answer	46	92	37	9
Incorrect answer	4	8	3	1
Christmas :				
Correct answer	47	94	37	10
Incorrect answer	3	6	3	0
<b>Age 7</b>				
Birthday :				
Correct answer	42	84	36	6
Incorrect answer	8	16	4	4
Christmas :				
Correct answer	40	86	34	6
Incorrect answer	10	14	6	4
<b>Age 4</b>				
Birthday :				
Correct answer	31	62	24	7
Incorrect answer	19	38	16	3
Christmas :				
Correct answer	38	76	31	7
Incorrect answer	12	24	9	3

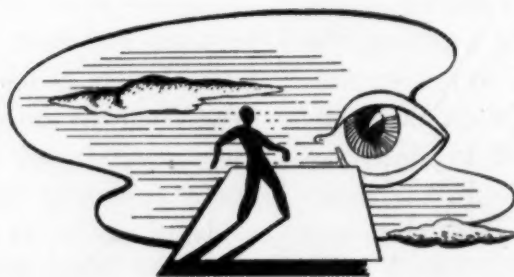
tion, subjects were asked to state the day of the week during which certain relatively recent events had occurred. An extremely small percentage gave correct answers to any of the questions, leading one to believe that when correct answers were given they were

largely owing to chance. After hypnotic induction, subjects were subjected to the usual tests for depth of hypnosis, such as the induction of positive and negative hallucinations, analgesia, and the inhalation of ammonium hydroxide (with the suggestion of inhalation of a pleasant perfume). They were then regressed year by year, using memorable dates as chronological landmarks. On such dates they were asked, "What day is this?" and their answers were scored against a 200-year calendar. Of the mixed group of 40 men and 10 women 82.3 percent gave entirely accurate answers to these questions, while the remaining 17.7 percent answered less than half the questions correctly. The inaccurate answers might well be explained by individual differences in retentiveness through developmental years or by the fact that this small group of people were dramatizing memories in the light of their present beliefs. It should be noted that all members of the test group had previously been regressed to at least the age of 5 prior to the sessions in which they were subjected to control. All were excellent somnambules and had been chosen from a group of 175 as being the best subjects. All questions asked were simple and direct. Subjects were merely asked on what days of the week Christmas and their birthdays fell in the particular years involved and were scored on the basis of regression to ages 10, 7, and 4.

A method of control of this sort is much easier to handle than some of the more involved techniques utilizing electroencephalography and the thematic apperception test, its simplicity making it more practicable clinically.

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# TECHNICAL PAPERS

## A Preliminary Report on the Study of the Relationship of Psychosomatics to Oral Conditions—Relationship of Personality to Dental Caries

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The influence of psychosomatic factors on bodily disorders has been established by the correlation found between clinical and psychological data. Such pathological conditions as duodenal ulcer (1, 27), mucous colitis (20, 25), asthma (5, 9, 10), chronic rheumatism and rheumatoid arthritis (12), and thyroid disorders (8, 13, 17), have been shown to have psychogenic factors. Many assumptions have been made that oral conditions may also have

TYPE OF SUBJECTS	NUMBER OF SUBJECTS	NEUROTIC TENDENCIES VS. D.M.F. SCORE	INTROVERSION EXTROVERSION VS. D.M.F. SCORE	SIGNIFICANCE LEVEL	
				5%	1%
MEN	25	+446	+405	.388	.496
WOMEN	25	+463	+447	.388	.496
MEN AND WOMEN	50	+474	+443	.276	.358

FIG. 1. Correlation coefficients.

a psychosomatic basis (6, 11). Sometimes these assumptions are based upon chemical tests of blood and saliva of institutionalized subjects (15, 24, 26), and more often merely upon clinical observations (18, 19). In no instance has there been statistical proof of a correlation between oral conditions and psychogenic factors. This study was initiated to discover whether such a correlation exists among persons who would be classified as normal from the psychiatric standpoint.

The Personality Inventory of Robert G. Bernreuter (2), and a modified D.M.F. (decayed, missing, filled) scale (14, 21) were employed as systems of measurement. Bernreuter's Personality Inventory is advantageous for our purposes in that it permits the measurement of several different traits of personality at one time without allowing the nature of the qualities under study to be readily discernible either by the examiner or by the person examined. It purports to measure neurotic tendency, self-sufficiency, introversion-extroversion, dominance-submission, confidence in one's self, and sociability. On our first 21 subjects, the inventory was scored for all six traits, but we discontinued scoring for all as soon as we discovered that only two traits, introversion-extroversion and neurotic tendency, were highly correlated with a dental condition. Snyder tests (22, 23) for acidophilus

bacilli were also run on the first 21 cases, but did not correlate with any Bernreuter traits. The high correlations were between D.M.F. and the two traits mentioned.

Therefore, we proceeded to increase the number of subjects to 50, equally divided as to sex. All subjects were faculty, students, or employees of Tufts College Dental School. The age, sex, and education of each person was recorded, but names were omitted in order to increase our expectation of obtaining truthful answers to the questions. The subjects were charted for the number of caries, fillings, and missing teeth. Each surface of a tooth containing caries or a filling was scored as one point.

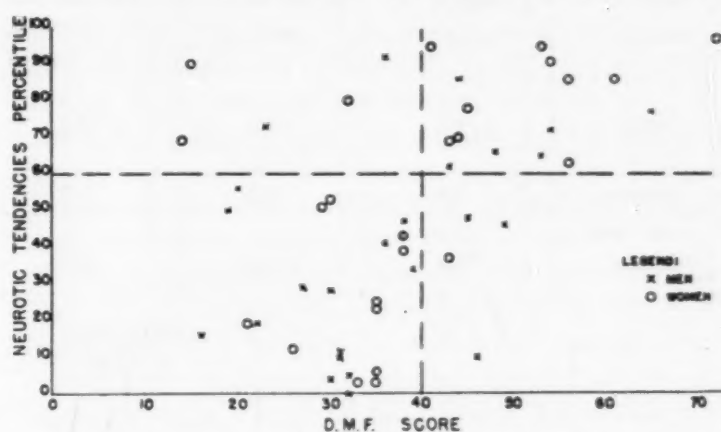


FIG. 2. Neurotic tendencies percentile vs. D.M.F. score.

Extracted teeth were scored as 3 points in accordance with the Bodecker system (3, 4), and Marshall-Day's A.C.F. (average caries frequency) ratings (7, 16). Decay around fillings was not counted unless it involved new sur-

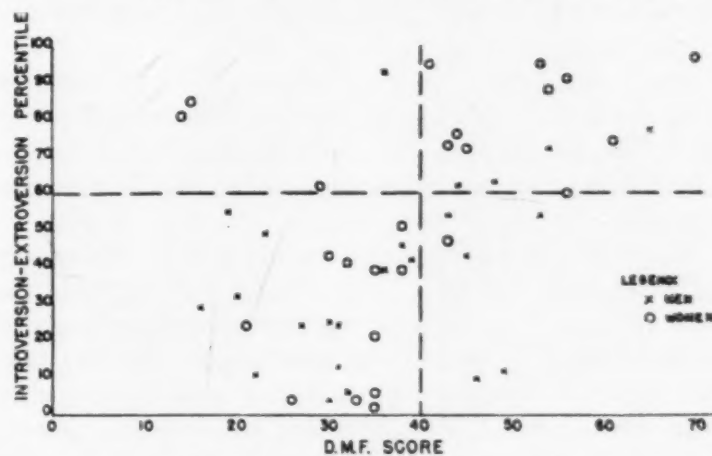


FIG. 3. Introversion-extroversion percentile vs. D.M.F. score.

faces, for such decay is usually considered to result from faulty restorations.

The D.M.F. score was then placed on the outside sheet of each Bernreuter test, and the tests were scored for introversion-extroversion and neurotic tendencies. Scoring was done with Bernreuter standard scoring sheets and percentiles were then found on the standardized scale.

The results are presented in Figs. 1-4. All but four of the subjects who were well below the lowest levels of

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neurotic tendencies (60 percentile and slightly below) had gained less than a 40 D.M.F. score, while those who were above these limits had, with but five exceptions, gained a D.M.F. score higher than this. The results obtained on the introversion-extroversion scoring showed that all but six of the subjects who were well within the normal limits had gained fewer than 40 points, and all but four above this limit had scored higher than 40.

The correlation coefficient for neurotic tendency percentile and D.M.F. points in men was +0.446, and for introversion-extroversion and D.M.F. points the coefficient was +0.405. These correlations are significant at the 5% level of confidence.

The coefficient of correlation between neurotic tendency percentile and D.M.F. points in women was +0.463, and

TYPE OF SUBJECTS	NUMBER OF SUBJECTS	NEUROTIC TENDENCIES	INTROVERSION EXTROVERSION
MEN	25	7.8	5.3
WOMEN	25	11.9	11.9
MEN AND WOMEN	50	19.8	10.9

SIGNIFICANCE  
 $\chi^2 > 3.84$

FIG. 4. Chi square values.

the introversion-extroversion coefficient was +0.447 which is also significant at the 5% level.

The combined correlation coefficients for the total 50 subjects were  $n_c + 0.474$  and  $i-e_c + 0.443$ . These are significant at the 1% level.

Another method of testing the relationship just shown is the chi square test, which was applied with the following tabulated results.

Since all of these results are well above the required 3.84, the data obviously have statistical significance. The mean results indicate that there is less than 1% possibility that the results might be owing to chance distribution.

The Bernreuter Personality Inventory is not necessarily an exact measurement of personality, but is today the best and most valid test of its kind to measure traits of personality as divorced from intelligence. Furthermore, the important fact is not so much that specific personality traits are measured, but rather that a correlation between some traits and oral conditions exists. The D.M.F. scales which we are forced to use are also not the final answer to the measurement of caries incidence, but again are the most valid we have at our command. Added to this, we have a good indication that the value of the correlation coefficient will prove to be above +0.40 if further studies are undertaken. This is surprisingly high if one realizes that the best correlations between medical disorders and psychic factors are rarely higher than +0.50. It appears that the correlation between psychological factors and oral conditions merits further investigation with different types and larger numbers of subjects.

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## A Preliminary Report on Histochemography<sup>1, 2</sup>

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During the summer of 1948, it was observed that normal rat bone marrow diluted with clear dog serum blackened an Eastman NTB photographic plate when smeared directly on the emulsion surface and stored at approximately  $-15^{\circ}$  C for several days. This observation was made on control experiments during an attempt to obtain single bone marrow cell autoradiographs.

Fig. 1 is a dark-field photomicrograph showing individual silver grains after development. The grains are

<sup>1</sup> A histochemograph is defined as a gross picture on a photographic plate or, at high magnification, a pattern of silver grains produced by the chemical action of a histological specimen in direct contact with the emulsion of the plate.

<sup>2</sup> This paper is based on work performed under contract with the U. S. Atomic Energy Commission at the University of Rochester Atomic Energy Project, Rochester, New York, and supported in part by the National Advisory Cancer Council of the U. S. Public Health Service.



grouped beneath cells<sup>a</sup> in some cases, but other groups are unassociated with cells. Examination of the gelatin of the emulsion indicated that the spots unassociated with

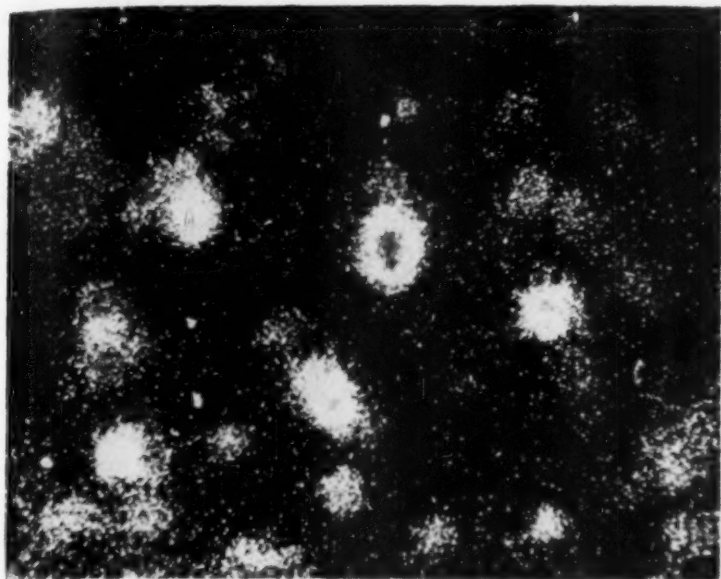


FIG. 1. A dark-field photomicrograph of a chemograph produced when rat bone marrow, diluted with dog serum, was smeared on an Eastman NTB photographic plate. Magnification approximately 666 $\times$ . Some groups of silver grains are in the emulsion beneath a single cell and extending for several  $\mu$  in all directions beyond the edge of the cell. This is illustrated by a bright spot (black spot in the original) with a dark spot in the center, the dark spot being the cell which has absorbed the scattered light from the grains beneath. Other bright spots show no cells present.

cells did not represent sites where cells had been washed away in the photographic fixing process, as was first suspected. The cause of the spots is unknown.

Peripheral blood from the same rat diluted with the same dog serum did not blacken the plate. The exposures continued for as long as 67 days. All plates developed serially showed that the bone marrow blackening increased in intensity with time while the peripheral blood smears showed no blackening, as can be seen from the background of the photographs published earlier in *Science* (1).

This emphasized the long-suspected likelihood of histochemical fogging and possible misinterpretation of autoradiographs from unfixed tissues. It was considered prudent to publish the results of preliminary experiments to bring this danger to the attention of those making autoradiographs.

A series of NTB plates were exposed to peripheral blood, spleen, kidney, liver, heart, and lung of a normal rat, sacrificed in the darkroom under a red light, Wratten Series I. A drop of blood was released from the jugular vein onto the emulsion and was not smeared. Slices of fresh organs were cut with a razor blade at 3–5-mm thickness and placed in direct contact with the emulsion. The tissues were on the emulsion at room temperature for 10–40 min, after which time they were stored at approximately  $-15^{\circ}\text{C}$  to prevent further autolysis.

<sup>a</sup> Because of the difficulty in properly staining the cells after passage through photographic developer and fixative, various observers could not agree on the identification of the cells; but it seems probable that those showing the greatest blackening were the earlier forms of the erythrocyte series.

The plates were removed serially in time. After warming the plates to room temperature and removing the organ slices with soaking in water, we developed them in dilute Eastman Kodak D19 (1 part D19 to 3 parts water) for 25 min. Photographic densitometer measurements were made. In general, the density increased with time. It is interesting that the blood, placed as a drop on the emulsion, showed a small amount of blackening in about 2 weeks, whereas the blood of the first rat, in the summer of 1948, when diluted with dog serum and smeared on the emulsion, showed no blackening after 67 days.

Some of the exposures showed patterns which, it was felt, corresponded to the architecture of the section surface. Fig. 2, a chemograph of a kidney cross section, shows striations and other patterns, which may have been produced by tubules or blood vessels in the cortex, and shows a reticular pattern in the medulla, although not evident in the illustration. This reticular pattern is composed of discrete lines 4–8  $\mu$  wide, intersecting to form tiny unexposed areas of varying size. These were observed to be coincident in position with the interstitial connective tissue or basement membrane of the medullary epithelium. In the cross section of the liver, the lobule parenchyma was indicated by heavy blackening and portal areas by lighter blackening of the emulsion.

The experiment was repeated with two variations: (1) the age of the rat was approximately 250 days as contrasted with 90 days for the rat of the first experiment; and (2) immediately upon removal of the organ from the rat, it was placed on dry ice and remained frozen during sectioning, placing on the emulsion, and storage until removal for development. The same patterns of



FIG. 2. A chemograph of a rat liver section placed in direct contact with an Eastman NTB plate. Magnification approximately 5 $\times$ . The cortex and medulla are clearly distinguishable.

blackening were obtained as in the first experiment, with the exception of the high reticular resolution in the kidney.

Recently, a desensitizing effect was observed when the spinal cord of a cat was placed in contact with an NTB emulsion surface for less than 30 sec, and the entire slide

exposed to light from an overhead incandescent lamp for less than 1 sec. The entire plate except that part in contact with the cord was black after development. The area in contact with the cord was composed of two parts. One was completely transparent, indicating complete desensitization of the emulsion to light, and was structurally associated with white matter. The other was very slightly blackened and was structurally associated with gray matter.

While we felt the blackening had been produced by direct chemical action, the possibility of blackening by

TABLE 1

RESULTS OF A TEST FOR PHOTONS PRODUCED BY A TISSUE AS DETECTED BY AN EASTMAN NTB EMULSION

		Tissue and emulsion separated by quartz slide		Tissue and emulsion in contact	
		Control not exposed	Exposed to ultraviolet light 5 min	Control not exposed	Exposed to ultraviolet light 5 min
2 hr	No image	No image	Image present, photographic density .07	Image present, photographic density .06	
24 hr	No image	No image	Image present, photographic density .14	Image present, photographic density .13	

photons produced in the fresh tissue could not be overlooked. It is well known that histological tissues produce photons by fluorescence after exposure to ultraviolet light. Usually fluorescence is produced only by ultraviolet light, is short-lived, and the number of photons is relatively large. In principle, however, there could be some compounds in the tissues which might be raised to a higher energy level by any portion of the spectrum and produce a delayed emission of a small number of photons. If this were so the photographic plate would integrate the effect over a long exposure, making observable a phenomenon unobservable instantaneously by the eye. There was also the possibility of a small number of photons from oxidative processes. Even though these possibilities seemed remote they were investigated in a preliminary manner.

Two series of experiments were carried out in which kidney and liver slices were separated from the photographic emulsion by (1) a glass cover slip and (2) quartz plates approximately 1 mm thick. In this experiment the animal, a rat, was dissected in the lighted room. After a 2-week exposure of the slices in the deep freeze, no image was observed.

In a repeat experiment using the kidney, a guinea pig was sacrificed in total darkness. Tissue slices exposed to ultraviolet light for 5 min and slices left in darkness were placed side by side on a quartz plate, which in turn was placed on an NTB plate. A similar set was placed in direct contact with emulsion of an NTB plate. The time from the end of ultraviolet exposure to placing on the photographic plates was about 3 min. The quartz plate

was 1 mm thick. The results are given in Table 1.

After both 2- and 24-hr exposures at approximately  $-15^{\circ}\text{C}$ , no image was found under the sections on the quartz plate. This indicates that the kidney picture shown in Fig. 2 was not produced by photons of fluorescence, oxidative luminescence, or any form of biochemical photon production in the range of wavelengths transmitted by the quartz and recorded by the NTB emulsion.

The experiments on direct contact, showing approximately equal densities for the tissues exposed and unexposed to ultraviolet light, for both 2 and 24 hr, indicate that there was no delayed emission of photons produced in the companion experiment and filtered out by the quartz. The interesting well-known observation of yellow fluorescence was seen on irradiation, but died out within a few seconds after the ultraviolet source was turned off.

As many of the autoradiographs made in this laboratory are fixed in Bouin's solution, experiments were run to test the possibility of artifacts from this source. Paraffin sections of rat lung, heart, kidney, and liver, which had been fixed in Bouin's solution, were placed in direct contact with an NTB plate. No blackening was observed after several weeks of exposure at approximately  $-15^{\circ}\text{C}$ .

These preliminary experiments indicate that Figs. 1 and 2 were produced by direct chemical action. It should not be inferred that these observations prove the non-existence of biochemically produced photons. Emulsions of different sensitivity or biological tissues under different conditions might show the production of a small amount of photons.

These results on NTB emulsions can be taken only as a warning when working with other emulsions. It does not follow that lantern slides or x-ray emulsions will show the same pattern or intensities. They may give the same or different patterns and may be more or less intense. For example, it is well known that hydrogen peroxide will fog many photographic emulsions (3), but it does not fog NTB emulsions. Also, the effect of histological fixative solutions and stains should be checked until proved harmless.

One advantage of the NTB plate, especially the NTB 2, or electron track plate, is that autographs can be differentiated from chemical fogging by virtue of the tracks for autographs and random grains for chemical fogging.

These observations suggest a new histochemical tool. The NTB plate with its low background fog and small grain size giving high resolution, is probably the best for this purpose, though other plates have not yet been tested.

It should not be inferred that this artifact makes autoradiography impossible. It does, however, emphasize the necessity of running controls on all solutions and tissues coming in contact with the emulsion. Another means of eliminating the artifact is by interposing a thin impermeable film between the subject of study and the emulsion. Stripping film is one type of emulsion designed for this purpose (2).

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## Some Observations on the Role of Folic Acid in Utilization of Homocystine by the Rat<sup>1</sup>

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Rats bred in this laboratory on our preexperimental diet, which has been described in detail (1, 4), have been shown to grow on a diet containing homocystine as the sole source of sulfur-containing amino acids, without known sources of labile methyl donors. The importance of the preexperimental diet for this phenomenon has been emphasized (1) and the possibility of stored factors involved in the utilization of homocystine suggested.

In subsequent studies, Sulfasuxidine was administered to rats under the same experimental conditions, on the assumption that the possible source of labile methyl donors could have originated from intestinal bacterial synthesis. This drug is known to be an inhibitor of intestinal synthesis of biotin and folic acid. The ability of the rats to utilize homocystine seemed to have been lost in conjunction with the destruction of the intestinal flora responsible for synthesis of folic acid, for growth could not be reestablished by dietary supplements of extra biotin and of folic acid concentrate or ryzamin-B (2, 5). This fact suggested that the bacteria synthesize a factor involved in the utilization of homocystine. However, the ability of the rats to utilize homocystine for growth could be reestablished with continued feeding of the sulfonamide by further supplementation of the diet with Liver Extract Lilly (LEL). These results could be interpreted as indicating that LEL furnishes to the rats factors made unavailable by the Sulfasuxidine. Since crystalline folic acid had become available, it seemed desirable to add it to the vitamin supplement to ensure adequate replacement of at least two vitamins involved, biotin and folic acid. The present report is concerned with the role of folic acid in the promotion of growth of rats on a labile methyl donor-free diet, containing homocystine as the sole sulfur amino acid, in the presence and absence of Sulfasuxidine.

The experimental procedure has been outlined in earlier publications (3-5). Table 1 gives a summary of the results obtained. The rats fed the Sulfasuxidine diet had received the basal diet approximately 50 days before the initial period reported in the table. Rats 34-37, littermates, show the best response to folic acid obtained under these conditions. The initial weight of the rats was 90.5, 80.5, 69.0, and 73.0 g, respectively; the average gain per day was 1.2, 0.9, 1.4, and 1.5 g. The growth response varies, however, in different individuals, and data for rat 62 are presented as an example of those animals that do not respond to folic acid even though growth is elicited in them by LEL. Still other rats, not reported here, showed intermediate degrees of growth.

The rats which did not receive the sulfa drug had been fed the basal diet approximately 34 days before the ini-

tial period reported in the table. When taken from the colony diet, at 36 days of age, the animals were depleted on the basal diet, without homocystine, for 14 days. Then on addition of homocystine they were allowed to regain their initial weight before the 26-day period reported; this took about 20 days. However, the rats received the extra biotin and folic acid from the beginning of the experimental period. The initial weight of the rats was 118.5, 119.0, 98.0, and 103.0 g, respectively; the average gain per day was 1.5, 1.7, 1.0, and 1.7 g.

TABLE 1

EFFECT OF FOLIC ACID ON THE GROWTH OF RATS FED  
A LABILE METHYL-FREE DIET CONTAINING  
HOMOCYSTINE WITH AND WITHOUT  
ADDITION OF SULFASUXIDINE

Rat Nos.	Diet	Days on diet	Food intake per day in g	Initial weight in g	Total gain in g	Gain per day in g
(With 2% Sulfasuxidine)						
34-37† Avg (4)	Basal*	12	2.9	78.3	-3.3	-0.3
	Basal + Ry‡ + Bi§	12	2.5	75.0	0.3	0.0
	Basal + Ry + Bi + Fo	28	4.2	75.3	34.9	1.3
	Basal + Ry + Bi	18	4.0	110.1	6.0	0.3
62	Basal	12	1.9	63.0	-3.0	-0.3
	Basal + Ry + Bi	10	2.0	60.0	-2.5	0.3
	Basal + Ry + Bi + Fo	16	2.1	57.5	0.5	0.0
	Basal + Ry + Bi + Fo + LEL¶	24	3.8	58.0	30.0	1.3
	Basal + Ry + Bi + Fo	8	4.0	88.0	1.0	0.1
	Basal + Ry + Bi + Fo	8	4.0	88.0	1.0	0.1
(Without Sulfasuxidine)						
88-91 Avg (4)	Basal + Bi + Fo	26	5.4	109.6	37.9	1.5

\* The basal diet consisted of a 17% amino acid mixture (5) and 0.83% homocystine. When Sulfasuxidine was fed it was added to the basal diet, which was given *ad libitum*. Rats 88-91 were restricted to 6 g of the diet for the first 16 days and ate *ad libitum* for the next 10 days. The standard dose of B vitamins was 500  $\gamma$  each of nicotinic acid, *p*-aminobenzoic acid, and inositol, 200  $\gamma$  of calcium pantothenate, 40  $\gamma$  each of thiamin hydrochloride, riboflavin, and pyridoxine hydrochloride, and 0.25  $\gamma$  biotin (5). The ryzamin-B, extra biotin, folic acid, and LEL were added to the standard vitamin mixture and fed daily. DL-Homocystine (100  $\pm$  0.5% by disulfide determination) was prepared in this laboratory by du Vigneaud's method modified by Brand (6, 7).

† Rats 34-37 were put back on the folic acid supplement in approximately 30 days and grew at practically the same rate for nearly 30 additional days, when the growth curves leveled off. When killed after 220 days on the synthetic diet, they weighed 181, 168, 166, and 153 g, respectively. On autopsy their livers did not appear fatty and weighed 7, 6, 8, and 6 g. Microscopic examination showed moderate fatty infiltration of the liver and some tubular degeneration of the kidneys.

‡ Ry signifies 62.5 mg of ryzamin-B unfortified (Wellcome Research Laboratories).

§ Bi signifies 2  $\gamma$  of biotin. Rats 88-91 received 1  $\gamma$  of biotin.

|| Fo signifies 20  $\gamma$  of folic acid (Folvite Lederle).

¶ LEL signifies 60.0 mg of Liver Extract Lilly.

<sup>1</sup> Aided by a fund in memory of Ruth C. Joyce.

Under these conditions the rate of growth is quite consistent; the presence of folic acid seems to prevent the acute reversible drops in weight observed in previous experiments (4). Of 12 rats studied on this diet, only one rat, number 90, showed a slight drop in weight with food consumption dropping to zero for one day. This rat also showed an early leveling-off of her growth curve on the 15th day of the reported period; the growth of the other rats did not level off until after the 26-day period.

The above experiments indicate that rats do not always lose their ability to utilize homocystine, under the conditions prevailing in these experiments, even though their intestinal folic acid synthesis has been checked by the sulfa drug, since addition of large doses of crystalline folic acid enables some rats to continue growth. The fact that only some rats respond to folic acid indicates that it is not the only factor involved. These animals retain a latent capacity for the utilization of homocystine, which seems to depend for its manifestation on a fairly high level of folic acid and is not destroyed by the sulfa drug. The nature of the variability of the growth response becomes apparent when we realize that other vitamin B factors are probably involved, the most conspicuous one being B<sub>12</sub>. These factors may be stored in the animals in varying amounts from preexperimental diets and may therefore be depleted in single animals at different periods of the experiment. Work is now under way to elucidate these problems.

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### Separation of the Ionic Species of Lysine by Means of Partition Chromatography<sup>1</sup>

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It is a cardinal principle in chromatography that for each compound there is only one position on the chromatogram; this locus is unique in the sense that all of the substance is contained within that position, but not in the sense that entirely different substances may not also occupy that position. As a corollary, it is believed that the appearance of two or more loci of substance indicate the presence of two or more different compounds. It is

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<sup>2</sup> The author desires to acknowledge the assistance of Mr. Leo Vernon in a portion of this work.

the purpose here to cite exceptions to this corollary, viz., that the presence of more than one locus of concentration may still be identified with a single substance.

We have found that paper partition chromatography of lysine<sup>3</sup> in a saturated phenol > water system may result

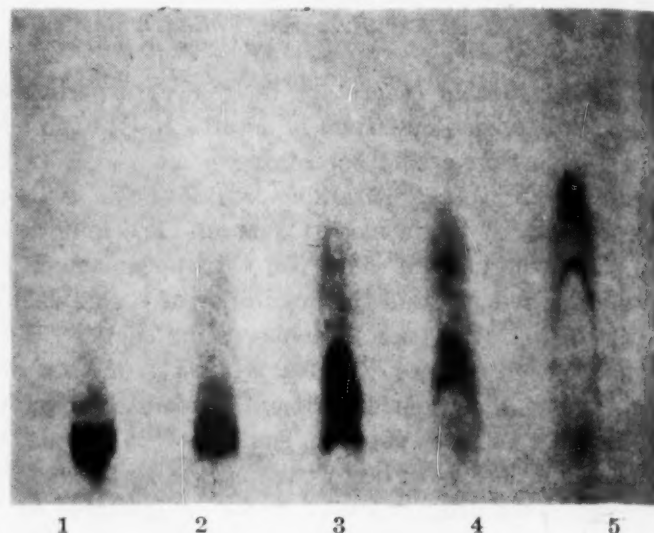


FIG. 1. Ninhydrin-developed spots of lysine aliquoted at various pH's: 1 at 2.20, 2 at 8.45, 3 at 9.50, 4 at 10.62, and 5 at 12.15.

in a plurality of spots. If from a relatively large volume of aqueous solution of lysine, small aliquots are taken for partition chromatographs, the number and position of these spots will depend upon the pH of the aqueous solution of the lysine (see Fig. 1). The relative intensities will be in rough accord with the distribution of ionic species for the different pH's as calculated from ioniza-

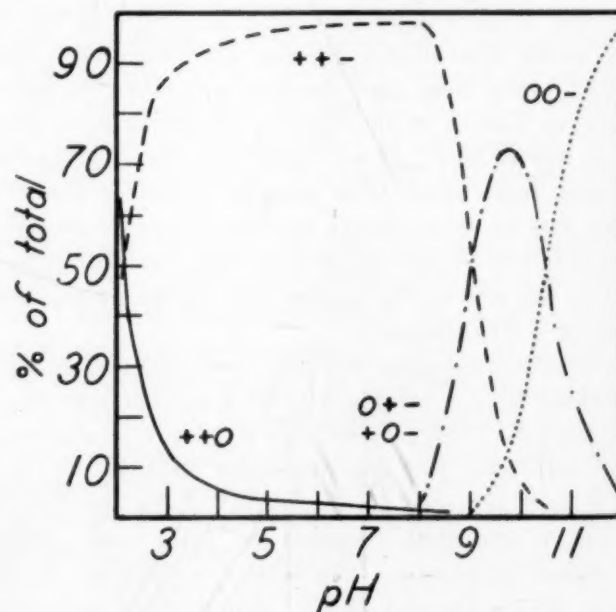


FIG. 2. The distribution of ionic species of lysine at various pH's.

<sup>3</sup> The lysine was purified by two recrystallizations, once as the picrate and again as the dihydrochloride. This procedure was followed for three different sources of material, all of which gave the same results: synthetic DL-lysine (monohydrochloride), naturally-occurring L-lysine (monohydrochloride), and lysine regenerated from the hydrolysis of aminohomopiperidone, and precipitated as the dihydrochloride. Melting points were in agreement with values in the literature (1).



tion constants (see Fig. 2). An unequivocal assignment of the spots to corresponding species is not necessarily possible, e.g., as in the two acid lysinates. The R's subject to temperature fluctuations, appear to correspond, respectively, to the free acid (++o) as 0.30, lysinate (++-) as 0.35, acid lysinates (o+- and +o) as 0.48 and 0.65, and free base (oo-) as 0.74.

The effect is absent in a basic solution, as collidine-water, or in a more economical medium which we have found equally effective for amino acid chromatography, butanol-water-pyridine (1:1:0.6). In either solvent the phenomenon does not appear with a polybasic amino acid, such as aspartic acid. It is possible that the use of stronger bases, such as the aliphatic amines, would be more effective with the weakly acidic groups. In phenol-water, arginine also yields long streaks rather than discrete spots, indicating a situation akin to that of lysine. The absence of the effect with histidine may perhaps be correlated with the relative weakness of its basicity.

An explanation of the phenomenon can probably be given along lines similar to those advanced by Westall (2) for the separation of inorganic ions in partition chromatography, i.e., basic lysine ions are capable of association with phenol. These associations are essentially new compounds, possessing their own partition coefficients and moving independently without charging the phases. The explanation assumes that in the phenol system the dissociation of phenol is so small that it does not cause drastic acidification of basic ions of lysine. Rough calculation of the volume of water in the phenol > water system bathing the spots shows that it probably does not exceed that used in the original aliquot; there is therefore no appreciable change of the intrinsic pH by dilution.

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## Demonstration of a Fatty Acid Oxidase in Frozen Poultry Fat<sup>1</sup>

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Lipoxidases have been shown to exist in plant material (6) and in animal tissues (1, 2). The Warburg technique has been used to demonstrate the ability of microorganisms to oxidize fats (2). The adipose tissue of rats has been shown to be enzymatically active (3, 5).

In the course of a study on the causes of rancidity of frozen chicken fat, an enzyme was prepared which oxidizes fatty acids. All birds<sup>2</sup> were killed by sticking, then were drawn, and frozen at 0° F. The adipose tissue was removed by permitting the carcass to thaw

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<sup>2</sup> We wish to thank Dr. W. J. Stadelman, of the Washington State College Poultry Department, for supplying the birds used in this work.

enough for skinning. Fat deposits from around the neck, the visceral cavity, and on the body were removed and

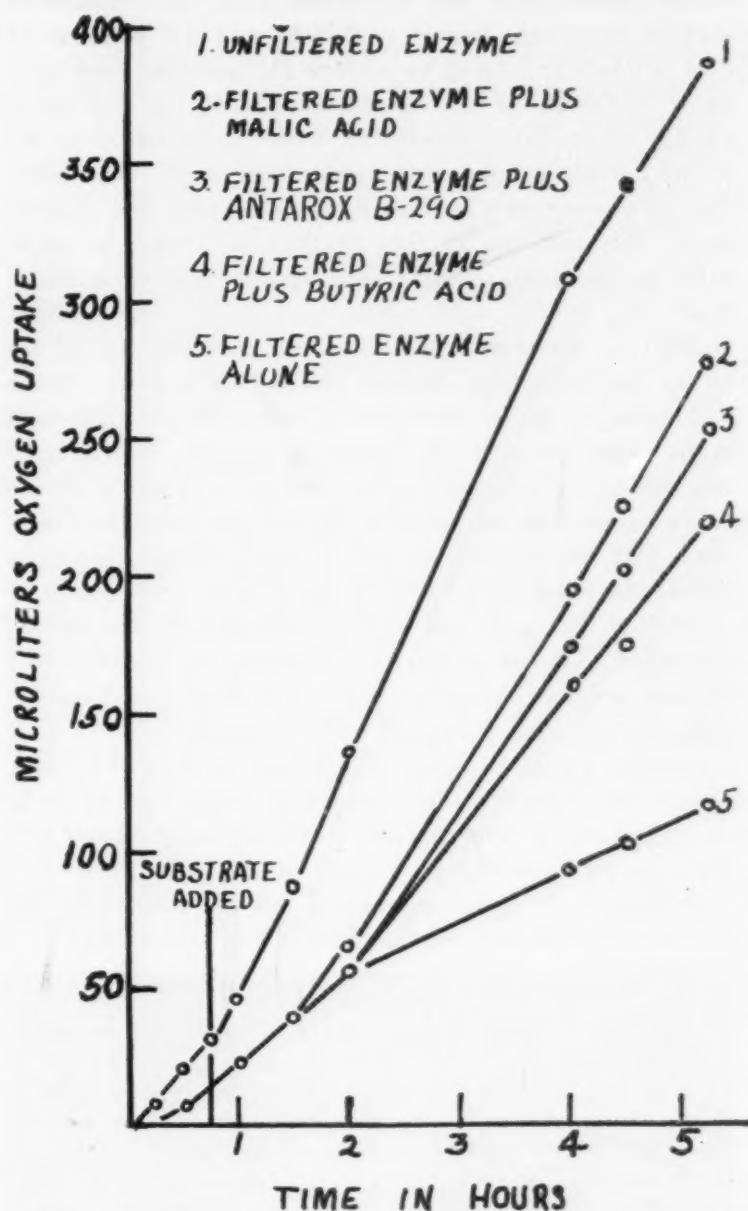


FIG. 1. Effect of different substrates on the oxygen uptake of the fatty acid oxidase.

pooled. Care was taken to include no muscle, skin, or connective tissue. This collected material was kept frozen until used—a period varying from 1 week to 3 months.

The enzyme was prepared by expressing the fat away from the tissue portion of the adipose material. The separated tissue was blotted on absorbent paper to remove excess fat, weighed, and homogenized with distilled water in a Potter homogenizer (4), 1 g of tissue in 30 ml of water. This mixture was centrifuged, the supernatant collected, and the residue washed twice by centrifuging with distilled water (10 ml of water for 1 g of tissue). Washings were combined with the previously prepared supernatant. Microscopically, the homogenate showed that some cell debris and fat globules were retained.

Using a Warburg Respirometer and an atmosphere of air at 37° C, the homogenate had an induction period of 4–6 hr (average of eleven trials was 5 hr). After the induction period in the presence of phosphate, Mg ion, and adenosine-5-phosphoric acid, there was a steady oxygen uptake, varying from 30 to 100  $\mu$ l/hr (average of nine trials was 65  $\mu$ l). Respiration continued for ap-

proximately 24 hr. Attempts to demonstrate the substrate for this respiration were unsuccessful.

The homogenate was combined with 1.2 volumes of 0.01 M phosphate buffer (pH 7.5) and 0.2 volumes of 0.04 M  $\text{MgSO}_4$ , filtered to remove fat globules, and aged at 37° C for 24–29 hr. Very little respiration was shown by 2.4 ml of this preparation with the addition of 0.2 ml of 0.0028 M adenosine-5-phosphoric acid. The addition of glucose as a substrate did not change the respiration. The addition to this mixture of 0.2 mM of oleic acid, linoleic acid, palmitic acid, stearic acid, tripalmitin, tristearin, butyric acid, acetic acid, or 3.3 mg AntaroX B-290<sup>3</sup> (a water-soluble castor oil polyethylene glycol ester) approximately doubled the oxygen uptake. Malic and fumaric acids, members of the tricarboxylic acid cycle, also doubled the oxygen uptake. Acids were neutralized with NaOH before using. A portion of the enzyme-phosphate-magnesium ion mixture which had been aged, but not filtered, showed a higher respiration than any of the substrates added to the filtered preparation.

Boiling the aged and filtered homogenate for 30 sec destroyed enzymatic activity. Dialysis of the unfiltered mixture against phosphate buffer and Mg ion during the aging period also decreased activity markedly.

Adipose tissue from five birds was used in this work and it was observed that there were large variations in the activities of preparations from different birds, and fat deposits from different parts of the same bird.

Further work is being carried out on substrates for this preparation and on the path of the oxidation.

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## A Simple Jet Type Air Stirrer<sup>1</sup>

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The paddle wheel type of air stirrer has been used in organic laboratories in order to reduce fire hazards. However, this type of air stirrer is noisy, clumsy, and lacks power. The jet type stirrer described in this article is almost noiseless in operation, compact, and has more speed and almost as much power as a variable speed stirrer.<sup>2</sup>

<sup>1</sup> Contribution No. 384, Department of Chemistry. Funds supplied by Office of Naval Research and Bureau of Animal Husbandry under Research and Marketing Act.

<sup>2</sup> Cenco, Central Scientific Apparatus Company, Chicago.

<sup>3</sup> Sample of AntaroX B-290 from Antara Products, New York.

The jet type stirrer can be made most conveniently from a 1-in. steel ball and brass or steel jets<sup>3</sup> (Fig. 1). A hole  $\frac{1}{4}$  in. in diam and  $\frac{1}{4}$  in. deep must first be drilled into one side of the steel ball, and a piece of steel  $\frac{1}{4}$  in. in diam and  $1\frac{1}{4}$  in. in length (A) inserted into the hole

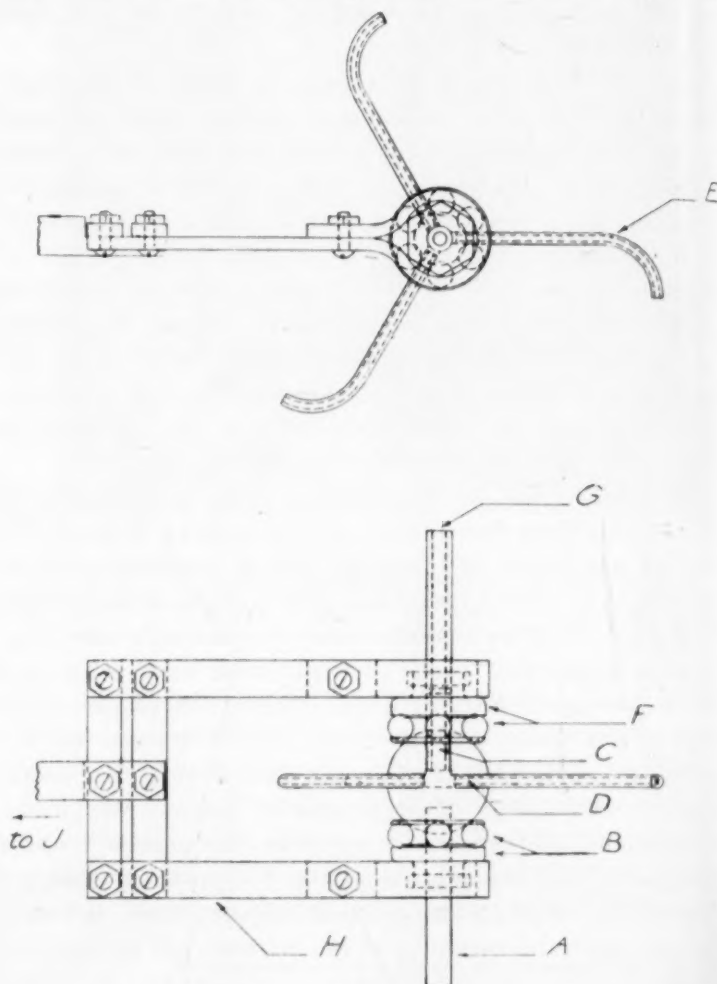


FIG. 1. Diagram showing construction of stirrer (guard around jets of hardware cloth 2 in. in width is not shown).

and brazed to the steel ball. The upper part of this  $1\frac{1}{4}$ -in. steel rod serves as a means of holding a ball-bearing race<sup>4</sup> and cone (B) and the lower part serves as a shank to which a stirring rod can be attached with either a piece of heavy rubber tubing or an ordinary steel chuck. A hole  $\frac{1}{4}$  in. in diam and  $\frac{1}{4}$  in. deep (C) must then be drilled directly opposite the steel rod, and three holes  $\frac{3}{32}$  in. in diam (D) at a 120° angle to each other drilled so as to contact the lower half of the hole which had been drilled at (C). The three holes at (D) are then threaded, and threaded brass or steel jets screwed into them. These jets are bent slightly at point (E). The hole at point (C) is also threaded and a  $\frac{1}{4}$ -in. threaded steel tube screwed into it. The upper end of the steel tube holds another ball-bearing race and cone and a babbitt bearing at (F). Another piece of steel tubing  $1\frac{1}{4}$  in. in length is threaded at one end and screwed into the bicycle cone. A piece of heavy rubber tubing is connected to the upper end of this steel tube and serves as an air inlet (G). The apparatus is held rigid by the steel bracket (H) clamped to a ring stand at (J). The speed of the stirrer can be adjusted by regulating the flow of compressed air.

<sup>3</sup> Ford V-8 carburetor jets or  $\frac{1}{4}$ -in. steel capillary tubing.

<sup>4</sup> Front wheel bicycle race and cone.



## Comments and Communication

### Do Amino Acids Fluoresce on Papergrams?

Before amino acid papergrams are treated with ninhydrin, it is customary to drive off the residual solvents by heating. It has been observed that the amino acid spots fluoresce under ultraviolet light at this stage, and fluorescence is frequently used when it is desired to locate the amino acids without reacting them with ninhydrin. This has led to an assumption which appears unwarranted, that it is the dry amino acids themselves that fluoresce.

In experiments with glycine and Whatman No. 1 filter paper, we have found that after heating, unchanged glycine can be extracted by washing with water, but the fluorescence remains behind on the paper. This, incidentally, leads to errors if an area located by fluorescence is water-extracted for subsequent evaluation by ultraviolet absorption. It is easy to demonstrate that the paper is essential for the development of fluorescence. We have air-dried spots from solutions of 21 common amino acids on filter paper (Whatman Nos. 1 and 50), and on glass plates. None of the dry spots fluoresced under ultraviolet light in the 3650-A region. After a few minutes' heating at 105° C, all the paper spots fluoresced. The spots on hardened paper fluoresced more brilliantly at first, but 3 hr of additional heating obliterated this difference.

None of the amino acid spots on glass fluoresced, even after 24 hr of continuous heating. A typical example may be seen in the figures. They show spots of the same amino acid (cystine), heated under identical conditions, on Whatman No. 50 paper and on glass. Photographed under tungsten light (Fig. 1), the paper spot is invisible and the glass spot is faintly outlined by a border of dried crystals. Photographed in the dark under ultraviolet light with process pan film and a Wratten A red filter (Fig. 2), the paper spot glows with fluorescence and the corresponding spot on glass is invisible because it does not fluoresce.

The production of fluorescence may be due to a reaction between the amino acid and the cellulose, similar to the nonenzymatic browning reaction. Most amino acid spots become visibly brown after prolonged heating. For example, 3 g glycine in solution, pulped with 60 sq in. Whatman No. 1 paper in a Waring Blendor and evaporated to dryness, showed brown discoloration and intense fluorescence after 6-hr heating. Neither browning nor fluorescence occurred under identical conditions with glycine or filter paper alone. It seems obvious that the molecular structure of the amino acid is not a prime factor in producing such fluorescence. All the amino acids produce similar results, the *sine qua non* being the filter paper. Heating speeds up the reaction but is not

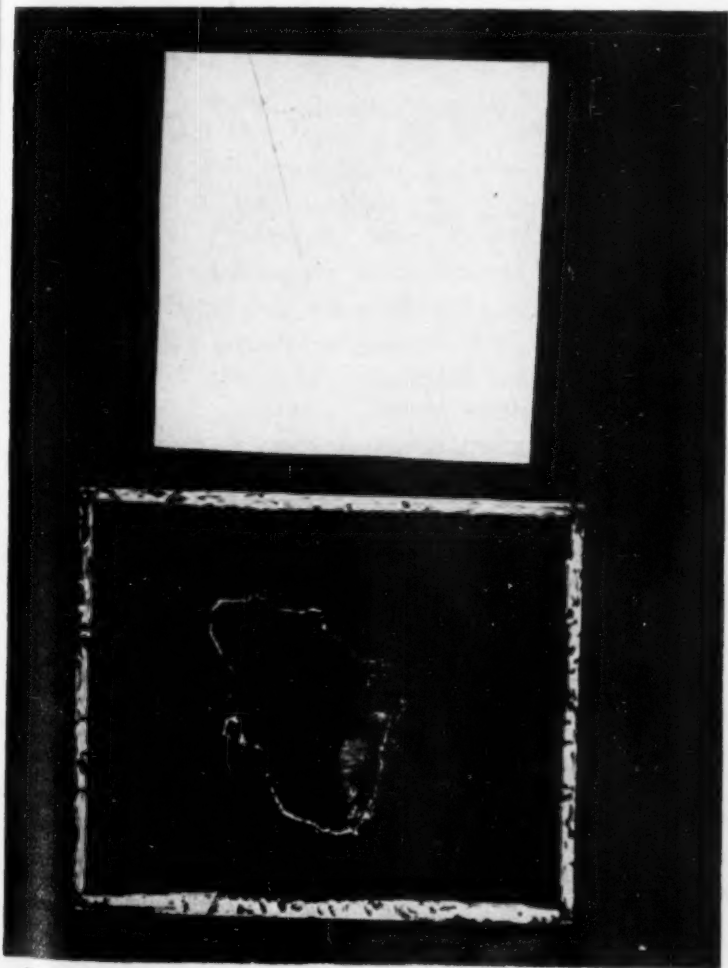


FIG. 1. Appearance of heated amino acid spot on filter paper and glass plate under tungsten light.

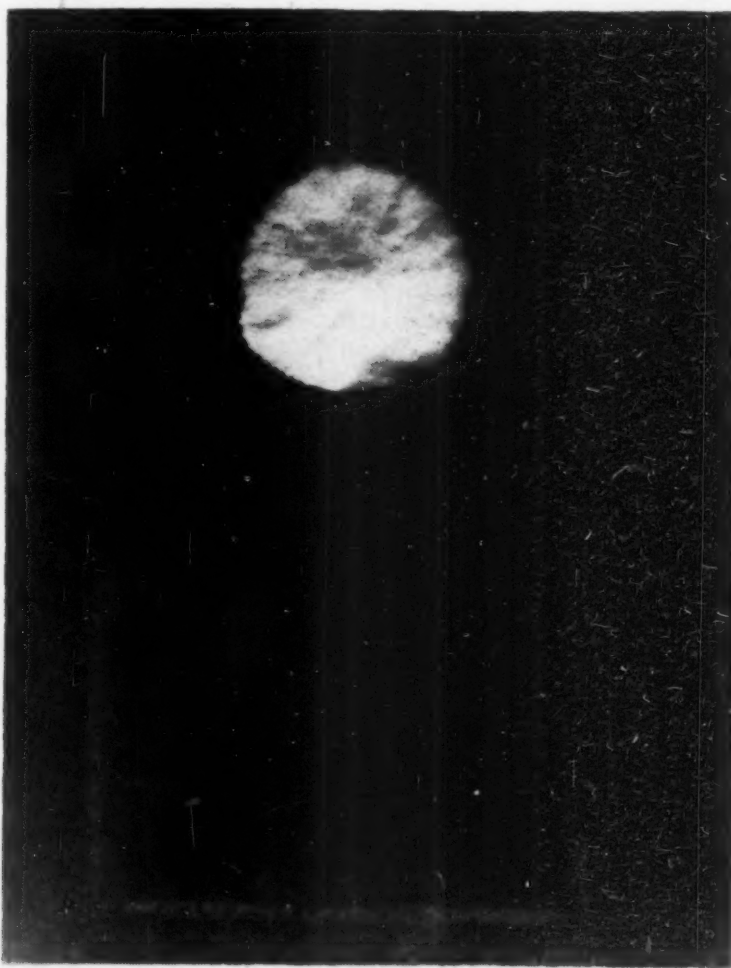


FIG. 2. Heated amino acid spot on filter paper and glass plate under ultraviolet light in the 3650-A region.

necessary; fluorescence develops slowly at room temperature. Drying from solution does seem to be necessary for the close contact required.

A. R. PATTON, ELSIE M. FOREMAN, and  
PATRICIA C. WILSON

Colorado A & M College, Fort Collins

### The Coxsackie Group of Viruses

It has become desirable to name those viruses that are pathogenic for suckling mice and hamsters, and that have recently been associated with "poliomyelitis" (Dall-dorf, G. and Sickles, G. M. *Science*, 1948, 108, 61; Dall-dorf, G. *et al.* *J. exp. Med.*, 1949, 89, 567; Melnick, J. L., Shaw, E. W., and Curnen, E. C. *Proc. Soc. exp. Biol. Med.*, 1949, 71, 344). I have felt that the disease should not be named until something is known of the anatomic lesions in man and a good deal more is learned of the range of symptoms and the relationship, if any, to classical poliomyelitis. On the other hand, a provisional designation is needed and it is suggested that the agent be called "Coxsackie virus," since the first recognized human cases were residents of that New York village. Since a number of viruses may be involved, the term "Coxsackie group of viruses" seems especially suitable. This provisional nomenclature has the support of those workers known to us to have experience with these agents, namely, J. L. Melnick and E. C. Curnen, of the Yale School of Medicine, and G. E. Quinby, R. S. Paffenbarger, and Beatrice Howitt, of the Communicable Disease Center, U. S. Public Health Service.

The term may properly be applied to viruses having the unusual host range described in published studies and the faculty of inducing severe, destructive lesions of the striated muscles, with or without encephalomalacia in immature mice and hamsters.

It is hoped that strain identification will be made only after reference to those strains that have now been studied.

GILBERT DALLDORF

Division of Laboratories and Research,  
New York State Department of Health,  
Albany

### Basic Issues in the Controversy on Zoological Nomenclature

A very important and basic controversy is now going on in zoological nomenclature. So far only scattered comments have appeared in public and these few statements present conflicting views. It is apparent to the members of this discussion group<sup>1</sup> that the basic issues

<sup>1</sup> The Nomenclature Discussion Group consists of 71 taxonomists of the Smithsonian Institution, the U. S. National Museum, the Bureau of Entomology of the U. S. Department of Agriculture, the Paleontology Branch of the U. S. Geological Survey, the Fish and Wildlife Service of the U. S. Department of the Interior, and the U. S. Public Health Service. This statement is signed by the members of the Steering Committee, as follows: R. E. Blackwelder, F. A. Chace, E. A. Chapin, D. H. Dunkle, R. Kellogg, J. B. Knight, C. F. W. Muesebeck, P. W. Oman, H. A. Rehder, C. W. Sabrosky, A. Stone, and A. Wetmore.

have not been sufficiently emphasized.

At Paris in July 1948, the International Commission on Zoological Nomenclature, which there consisted of four regular commissioners and eight or nine alternates appointed for the occasion, adopted a far-reaching program of reform, a program prepared at great length by the secretary. This program included (1) authorization for a rewriting of the code around a set of stated principles; (2) action on a large number of individual amendments, none of which had previously been voted on by the commission; (3) entrusting to "jurists" the preparation of the text of the new code in "watertight legal language"; and (4) a complete reorganization of the commission, its size, its method of selecting members, and its bylaws. Most of this was without advance notice to zoologists or to the commission, and neither the commissioners nor the alternates at Paris had opportunity to study the voluminous agenda in advance of the meeting.

The following facts stand out as the basic issues: (1) the most momentous actions of a half-century in zoological nomenclature were taken at Paris without preliminary announcement, without the usual opportunities for consideration by zoologists in general, and without prior study and approval by the regular commissioners; (2) in many cases approval was given only "in principle," with no provision for review of the principles and with the actual wording left to a committee of jurists; (3) not only was no provision made for review of these principles, but no right was reserved for the regular commission, the international congress, or zoologists to accept or reject the final wording of the proposed revision or any of its parts before promulgation.

It is clear that the program which produced these issues was created and fostered by the secretary of the commission, who no doubt believed that his actions were desirable and necessary to improve the nomenclatural situation. Nevertheless, shorn of all obfuscations regarding "mandates from the congress," dangers of delay, and similar assertions, the means taken to effect the ends are contrary to the principles and practices on which international cooperation in nomenclature was established and by which it has functioned for nearly half a century.

Such actions strike at fundamentals. If they are allowed to stand, international cooperation in nomenclature will be a farce, the confidence upon which support of the commission has been based will be lost; and the accomplishments of years in the field of zoological nomenclature will be jeopardized.

If confidence is to be maintained and international cooperation made secure, any plan for revision of the code must have widespread approval. Zoologists must be permitted to see any such proposals and express their reactions, the full commission must study all proposals, as well as the comments of zoologists, and pass judgment on them, and, if it still seems desirable to maintain the formality, the following International Congress of Zoology must formally approve the final draft.

STEERING COMMITTEE,  
NOMENCLATURE DISCUSSION GROUP

Washington, D. C.



# NEWS and Notes

The Royal Swedish Academy of Engineering Sciences has elected to membership **Glenn T. Seaborg**, Swedish-born chemist at the University of California in Berkeley.

**Herman Mark**, director of the Polymer Research Institute at the Polytechnic Institute of Brooklyn, has been invited by the Indian National Research Council to visit India in January and February and to deliver lectures on the scientific and practical aspects of the physics and chemistry of high polymers in universities and research institutions in Bombay, Delhi, Calcutta, Bangalore, and Madras. He will address the meeting of the Indian Academy of Sciences, December 29-31, in Bombay, and that of the Indian Association of Science in Poona, January 2-8. Dr. Mark is a member of the Indian Academy of Sciences.

**Holbrook Mann MacNeille**, chief of the Fundamental Research Branch of the U. S. Atomic Energy Commission, assumed executive directorship of the American Mathematical Society on November 14.

**Lyman C. Craig**, of the Rockefeller Institute for Medical Research, will deliver the third Harvey Lecture of the current series at the New York Academy of Medicine on December 15. Dr. Craig will speak on "Isolation and Characterization of Biologically Important Substances."

**Perry W. Gilbert**, associate professor of zoology at Cornell University and currently on sabbatic leave, is studying the origin and development of the human extrinsic ocular muscles as a guest investigator at the Carnegie Laboratory of Embryology, Baltimore. Dr. Gilbert will resume his teaching duties at Cornell on February 1.

**George G. Gallagher** was recently appointed assistant manager of the

Raw Materials Operations Office of the U. S. Atomic Energy Commission, where he will have direct supervision of the domestic uranium program of the AEC. He replaces **Jesse C. Johnson**, who recently became deputy manager. Before joining the AEC staff, Mr. Gallagher was general superintendent of the Compania Minera Venturosa in Mexico. During the war and until 1947 he was an engineer examiner in the mining section of the Reconstruction Finance Corporation.

**William Vogt** has resigned as chief of the Conservation Section of the Pan American Union, effective November 15.

**John B. Youmans**, dean of the University of Illinois College of Medicine, has resigned to take a similar post at Vanderbilt University, effective March 1, 1950. Dr. Youmans will succeed **Ernest Goodpasture**.

**Guenter Schwarz** and **George L. Rogosa** joined the staff of the Florida State University Physics Department this fall. Both men were formerly at the Institute of Cooperative Research, Johns Hopkins University.

**Walter G. Schindler**, Rear Admiral, USN, has been made deputy chief of research at the Navy's Bureau of Ordnance. He succeeds **Frederick I. Entwistle**, Rear Admiral, USN.

## Visitors to U. S.

**George Vaux**, French archaeologist and professor at the Sorbonne is a visiting member of the Harvard University Classics Department, where he will lecture on Delphi.

**Yoshio Kusama**, chairman of the Japanese Council on Medical Education, and professor of preventive medicine at Keio University Medical School, Tokyo, is making a tour of leading American medical centers. He will return to Japan about the middle of February.

**Sunder Lal Hora**, director of the Zoological Survey of India, Indian Museum, Calcutta, visited centers of

zoological, fisheries, and oceanographic research in this country last month. During his stay he lectured at Yale, Berkeley, Washington University, and the University of Michigan, and at the National Museum and the Fish and Wildlife Service at Washington, D. C. His subjects were fish farming, with special reference to Indian and Chinese practices; study of adaptations among torrential fishes of India; and the zoogeography of India.

Visitors at the National Bureau of Standards last month included **N. D. Hill**, engineer, Research Laboratories of Elliot Brothers, London; **R. M. LeLacheur**, research physicist, National Research Council of Canada, Ottawa, who will be here for several weeks; **Torvald Malmstrom**, assistant director, Swedish Royal Academy of Engineering Sciences, Stockholm; **D. H. Sadler**, superintendent of H. M. Nautical Almanac Office, Royal Greenwich Observatory, Hailsham, Sussex; **F. Svensson**, of the Aeronautical Research Institute of Sweden; **Manuel S. Vallarta**, professor at the University of Mexico, temporarily with the Institute for Advanced Studies, Princeton; **Max Freson**, secretary, National Research Council, Brussels; **A. C. Menzies**, physicist, and controller of Research and Development, Hilger and Watts, Ltd., London; **S. A. Shareef**, director of engineering development, Government of Pakistan; and **A. C. S. van Heel**, professor, Technical University of Delft, Netherlands.

**E. E. Evans-Pritchard**, professor of anthropology at All Souls College, England, will be a visiting professor in the University of Chicago's Department of Anthropology during the winter quarter.

**Abelardo Moreno**, of the University of Havana, is in Washington, D. C. on a Guggenheim fellowship for one year's study. Dr. Moreno may be reached at the National Museum, Division of Birds.

**Simón Markovich**, head of the Department of Neurophysiology at the Central Institute of Neurosurgery and Neuropathology, Santiago, is at Columbia University for a

year's postgraduate work. Dr. Markovich has a U. S. Public Health Fellowship.

## Grants and Awards

The American Institute of Chemists will award its 1950 gold medal to Walter J. Murphy, editor of the American Chemical Society's *Chemical and Engineering News*, *Industrial and Engineering Chemistry*, and *Analytical Chemistry*. The medal is awarded annually for noteworthy service "to the science of chemistry or the profession of chemist in America." Dr. Murphy was cited as "a great editor, who has focused the world's attention on chemists and their contributions as professional men." He will receive the award at the institute's annual meeting in New York in May.

The Harvard Foundation for Advanced Study and Research announced last week that the university had received an unrestricted gift of \$50,000 from the Mallinckrodt Chemical Works of St. Louis.

The Albert and Mary Lasker Foundation awards for 1949 of the Planned Parenthood Federation went to Carl G. Hartman for his researches in embryology and reproduction, particularly in regard to ovulation, and to George M. Cooper for his outstanding services to maternal and child health in North Carolina.

The Nutrition Foundation, Inc. has approved grants-in-aid to the following institutions: University of California—\$3,000 annually for two years to M. S. Dunn for the study of the functions and microbiological analysis of amino acids; University of Cincinnati—\$2,500 annually for two years to Joseph Warkany for the study of diet and congenital malformations, and \$5,000 to G. M. Guest for clinical and experimental research on diabetes, especially in the young; University of Rochester—\$2,000 to K. E. Mason for the study of the nature and significance of a pigment associated with vitamin E deficiency; University of Minnesota—\$4,600 for two years to P. D. Boyer for studies on the metabolic function of vitamin E; A. & M. College of

Texas—\$2,000 annually for two years to C. M. Lyman to study the biochemical reactions leading to the synthesis of amino acids; Syracuse University—\$3,000 to W. W. Westerfeld to study carbohydrate and purine metabolism; University of Iowa—\$1,800 annually for two years to C. P. Berg to study the metabolism of amino acids; University of Florida—\$2,500 annually for two years to G. K. Davis to study the interrelationships of molybdenum, copper, and phosphorus in animal metabolism; Western Reserve University—\$1,500 to I. Pyle and N. L. Hoerr for charts on the bone development in children and reference standards based on x-ray records; Children's Hospital, Boston—\$5,000 to S. B. Wolbach to study vitamin and mineral deficiencies and excesses; University of Pittsburgh School of Dentistry—\$3,000 to Gerald J. Cox to study factors in the diet that control tooth development, and \$3,000 annually for two years to B. F. Daubert to study the development of methods for the micro-estimation of unsaturated fatty acids; Cornell University Medical College—\$3,000 annually for two years to Donald B. Melville to study the biochemical significance of compounds related to histidine, and \$3,600 annually for three years to Richard E. Lee to study the dietary factors involved in maintaining the integrity of the peripheral vascular system; and Columbia University—\$4,000 annually for two years to D. Rittenberg to study precursors of cholesterol.

## Colleges and Universities

The University of Chattanooga formally dedicated its new \$500,000 science building on November 19. The building is named Brock Hall in honor of William E. Brock, former U. S. Senator, who has served for 30 years on the university's board of trustees. The building's medical research laboratory, established by John B. Haskins, Chattanooga physician, was also dedicated and is to be known as the John B. Haskins, Jr. Memorial Laboratory.

Stevens Institute of Technology's Graduate School has opened

a laboratory for its recently established Department of Fluid Dynamics. The laboratory is equipped for research in the mechanics of fluid flow by visualization processes such as shadowgraphy, striation photography, and interferometry. A two-dimensional wind tunnel, designed by Bela K. Erdoss, chairman of the new department, is being built in the laboratory.

## Meetings and Elections

The American Geological Institute held its second annual meeting November 13 in El Paso, Texas. The meeting was devoted primarily to a consideration of the long range program of the institute, the election of officers for 1950, and discussion of several projects which should be completed within the next few months.

Officers elected by the board of directors for the coming year are: president, William B. Heroy, Beers and Heroy, Dallas; vice president, Earl Ingerson, U. S. Geological Survey, Washington, D. C.; secretary-treasurer, Ernest Cloos, The Johns Hopkins University, Baltimore.

The institute is composed of 11 national scientific and professional societies. The constitution provides, however, that nonprofessional organizations interested in the geological sciences may be admitted as non-voting affiliates, and the board voted to encourage the affiliation of such organizations whose programs are consistent with the objectives of the institute.

The board also adopted a program to assist the progress of geological work and research. The program will include specific activities concerned with the training of professional geologists, the role of geological material in general education at the college level, the integration of geological material in school curricula and in adult education, and an investigation of the entire method of teaching geological science. Specific plans for cooperation with state education commissions, state geological surveys, and local educational institutions are being studied.

The scope and nature of the present program of geological field education offered during the summer



months are also under study. A report describing all summer geology field courses to be offered in 1950 and summarizing the 1949 program will be issued soon. The institute also plans to compile specific information concerning the utilization of earth science in the high school curricula throughout the U. S.

The report of the Committee on Geological Personnel showed that the wartime deficit of geologists trained to the bachelor level has been overcome. As a result, the institute will initiate early next year an annual supply and demand study of geological personnel, combined with a study of both the training and the personal qualities which have led to success in various types of geological endeavor, and an investigation of present functional distribution of geologists in the U. S.

The compilation of a catalogue of geological field trip guidebooks, with index maps showing areas covered by each, is also planned. A number have been prepared by agencies including the U. S. Geological Survey, the International Geological Congresses, and local societies. Many state geological societies have issued valuable guidebooks in connection with their annual field tours. For example, the field trips sponsored by the El Paso meeting of the Geological Society of America were covered by a series of excellent guidebooks prepared by the West Texas Geological Society, but much of the original information, which is highly scientific, has never been published. The proposed compilation should be of use to professional geologists, students, and amateurs studying these regions.

Another study will deal with the exchange availability of geological material useful in teaching or for display. In the past, exchanges have largely been arranged by individual geologists. The proposed catalogue will make this information available to geology departments and others who wish to build up their teaching and display materials.

An analysis of unpublished research in geological science will also be undertaken, primarily in the North American continent. It is

planned to compile this information annually or biannually for the assistance of research workers in the geological sciences. An investigation of the current status of geological mapping in the U. S. will also be made as a basis for recommendations for future action in this area of geological work.

The board of directors also approved a public information program through the use of local speakers and nontechnical pamphlets and guides to inform the public about geological features of state and national parks and areas of scenic interest. This would include a speakers' bureau to supply speakers on nontechnical geological subjects to interested organizations. The program will be integrated at the state and local level.

The board endorsed a program of specific cooperation with the National Defense Establishment concerning the use of geological techniques and geologists in national defense, and proposed a careful analysis of the means whereby the institute may be of service to federal and state agencies participating in or sponsoring geological programs. Recommendations of the Committee on Publications to study the possibility of publishing a monthly journal of geological abstracts were also approved.

The board emphasized that the function of the institute is to serve the geological profession, and thereby the individual geologist. The success of the program will depend on the participation of individuals and those interested in any phase of the program are urged to write to institute headquarters.

DAVID DELO, *Secretary*

Two state academies of science will hold meetings this week: The **Tennessee Academy of Science** at Southwestern University, Memphis, Tennessee, December 2-3, and the **Oklahoma Academy of Science**, at Phillips University, Enid, Oklahoma on December 2.

The **American Institute of Mining and Metallurgical Engineers** elected the following officers at the meeting of the board of directors, November 16: president, Donald H.

McLaughlin, head of the Homestake Mining Company, San Francisco; vice presidents, Andrew Fletcher, president of the St. Joseph Lead Company, and Robert W. Thomas, general manager of the Nevada Consolidated Copper Corporation.

## Deaths

**Clarence Olds Sappington**, 60, authority on industrial medicine and hygiene, died of a heart ailment November 6 at his home in Chicago. Dr. Sappington was editor of *Industrial Medicine and Surgery*, and director of the Division of Industrial Health of the National Safety Council from 1928 to 1932.

**Harry T. Gisborne**, 56, chief of the Division of Forest Fire Research at the Northern Rocky Mountain Forest and Range Experiment Station, died of a heart attack November 9. Mr. Gisborne was internationally known for his method of calculating fire hazards in forests through measurement of humidity, fuel moisture, precipitation, and wind velocity. Shortly before his death he worked with General Electric engineers on experiments to control lighting.

**George B. Sartoris**, 53, principal agronomist, Division of Sugar Plant Investigations of the Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture, died of a heart attack at his home in University Park, Maryland, November 19. Dr. Sartoris had been a member of the department since 1923; he had been engaged in breeding research on sugar cane since 1934. At the time of his death he was in charge of the sugar cane and sugar sorghum projects of the bureau.

**Daniel B. Feer**, 25, assistant professor of physics in the College of Engineering, New York University, died of a heart attack on November 8. Dr. Feer specialized in the quantum theory of fields and in elementary particle physics. During the war he was a special research associate in the Electroacoustic and Systems Research Laboratories of Harvard University. He spent the year 1948-49 in the School of Mathematics of the

Institute for Advanced Study at Princeton.

**Representatives of the U. S. Atomic Energy Commission and the Government of the United Kingdom** recently conferred with the South African Atomic Energy Board on problems relating to the production of uranium in the Union of South Africa. The discussions, held in Johannesburg, were a continuation of previous conferences of the three governments. Representatives of the U. S. were J. K. Gustafson, manager of the AEC Raw Materials Operations Office; Thorold Field and Robert Macdonald, technical advisers to Dr. Gustafson; and A. A. Wells, special assistant to the AEC General Counsel.

**The Council of the Organization for European Economic Cooperation**, composed of representatives of all countries receiving Marshall Plan aid, has agreed that each of the 18 governments will make available to all the others documents dealing with scientific, technological, and economic matters of importance to industrial production. The exchange is expected to begin early next year and will provide for translation and reproduction of documents, subject to agreement of the country supplying them. The council also urgently recommended compilation of national surveys of documentary sources and technical information services, as well as listings of leading experts and research units in various technical fields.

**Laboratory training courses in communicable diseases** will begin January 1 at the Communicable Disease Center, Atlanta, Georgia. Twenty-five courses of one to four weeks' duration will be offered during the year. Information and applications should be requested from the Chief, Laboratory Division, Communicable Disease Center, 291 Peachtree Street, N.E., Atlanta, Georgia.

**The Oak Ridge Institute of Nuclear Studies** announces that some vacancies still remain for the winter series of three radioisotope techniques courses offered by its Spe-

cial Training Division (see *Science*, October 7, p. 386). Interested persons are urged to apply for one of the winter courses, in view of the heavy load of applications for participation in the summer courses. Starting dates are January 2, January 30, and March 6. Requests for application and information should be addressed to Dr. Ralph T. Overman, Chairman, Special Training Division, Oak Ridge Institute of Nuclear Studies, P. O. Box 117, Oak Ridge, Tennessee.

**The Kresge-Hooker Scientific Library** is seeking to fill the vacancy created by the death of Neil E. Gordon, Wayne University chemistry professor. Qualifications include ability to edit the *Record of Chemical Progress*, direct off-campus translational services of the library, direct other library activities among chemists in industrial and academic fields, and do part-time teaching in the chemistry department. The rank of professor is available for the position. Applications should be addressed to The Friends of the Kresge-Hooker Scientific Library, Wayne University, Detroit 1, Michigan.

### Recently Received—

**Agricultural Climatology of Japan and Its Agro-Climatic Analogies in North America.** M. Y. Nuttonson. International Agro-Climatological Series, Study No. 8, 1949. On request from American Institute of Crop Ecology, P. O. Box 1022, Washington, D. C.

**Life at Letchworth Village.** 40th annual report, Board of Visitors, March 31, 1948. Department of Mental Hygiene, Albany, New York.

**Proceedings of the Hawaiian Academy of Science.** 24th annual meeting, 1948-49. University of Hawaii, Honolulu, T. H.

**Department of Scientific and Industrial Research Report, 1947-48, with review of 1938-48.** His Majesty's Stationery Office, London, 2 S.

**Bausch & Lomb Optical Glass.** Catalog E-30. Bausch & Lomb Optical Company, Rochester 2, New York.

**The Electron Microscope and Its Application to Materials Problems,** PB 97957. Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. \$1.25.

**Stress Analysis.** Armour Research Foundation, Illinois Institute of Technology, Technology Center, Chicago 16.

**Report on the Principles of Rheological Nomenclature.** H. M. Burghers and G. W. Scott Blair. Joint Committee on Rheology of the International Council of Scientific Unions. North-Holland Publishing Company, Amsterdam.

**Guide for the Identification and Reporting of Stranded Whales, Dolphins, Porpoises, and Turtles on the British Coasts.** F. C. Fraser and H. W. Parker. British Museum, London. 2 S.

**Exploradores Famosos de la Naturaleza Venezolana.** Eduardo Röhl. Third Inter-American Agricultural Conference. El Compañ, Caracas, Venezuela.

**Catalog of Periodical Publications in the Libraries of Mexico City.** Section of Medicine and Biological Sciences. Benjamin Franklin Library, Mexico, D. F.

**Guide to the Medicinal and Poisonous Plants of Queensland.** L. J. Webb. Council for Scientific and Industrial Research, Bull. 232. Melbourne, Australia.

### Make Plans for—

**American Academy of Optometry,** annual meeting, December 10-13, Cleveland, Ohio.

**Entomological Society of America,** 44th annual meeting, Tampa, Florida.

**American Psychoanalytic Association** midwinter scientific meeting, December 17-18, Hotel Statler, New York City.

**American Chemical Society,** 160th annual chemical engineering symposium, December 29-30, Ohio State University, Columbus.

**American Meteorological Society,** 104th national meeting, January 4-6, Hotel Jefferson, St. Louis, Missouri.